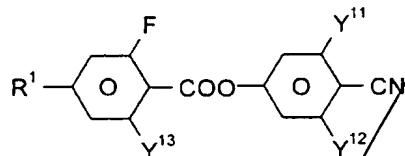


Patent Claims

5
1. An electro-optical liquid-crystal display comprising a realignment layer, for realigning liquid crystals, and a liquid-crystalline medium of positive dielectric anisotropy,

10 wherein said medium comprises one or more compounds of formula I



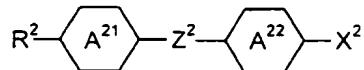
15 wherein

15 R¹ is H, alkyl having 1 to 7 carbon atoms, alkoxy having 1 to 7 carbon atoms, alkenyl having 2 to 7 carbon atoms, alkenyloxy having 2 to 7 carbon atoms or alkoxyalkyl having 2 to 7 carbon atoms, and

25 Y¹¹, Y¹² and Y¹³ are each, independently of one another, H or F; and

wherein when an electric voltage is applied to said display an electric field is generated which has a component parallel to the liquid-crystal layer for realignment of the liquid crystals.

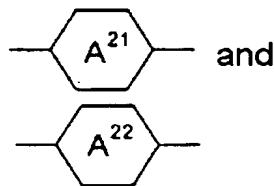
30 A liquid-crystal display according to Claim 1, wherein said medium comprises one or more compounds of formula II.



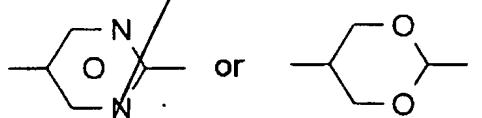
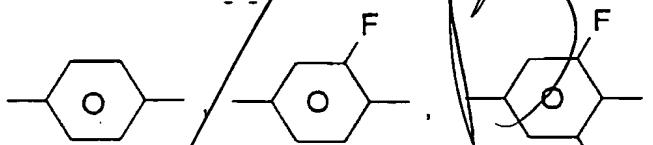
II

wherein

5 R^2 is alkyl having 1 to 7 carbon atoms,
 alkoxy having 1 to 7 carbon atoms,
 alkenyl having 2 to 7 carbon atoms,
 alkenyloxy having 2 to 7 carbon atoms
10 or alkoxyalkyl having 2 to 7 carbon atoms,

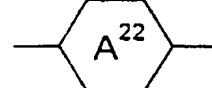
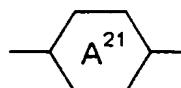


are each, independently of one another,

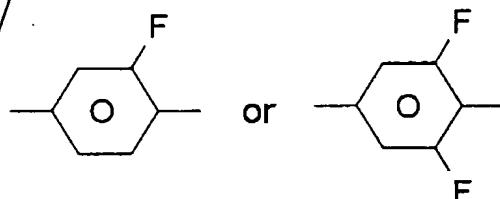


and

15 at least one of



is



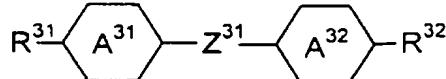
20

X^2

is F, Cl or CN; and

Z^2 is $-\text{CH}_2\text{CH}_2-$, $-\text{COO}-$, $-\text{CF}_2\text{O}-$ or a single bond.

- 5 3. A liquid-crystal display according to Claim 1, wherein said medium comprises at least one compound of formula III



III

10

wherein

15 R^{31} and R^{32} are each, independently of one another, alkyl having 1 to 7 carbon atoms, alkoxy having 1 to 7 carbon atoms, alkenyl having 2 to 7 carbon atoms, alkenyloxy having 2 to 7 carbon atoms or alkoxyalkyl having 2 to 7 carbon atoms,

20

and
are each, independently of one another,

or
, and

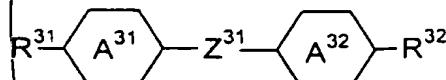
The diagram shows two chemical structures. The first structure, labeled 'and', consists of a hexagonal ring with an 'A³¹' group attached to its top-left position. The second structure, also labeled 'and', consists of a hexagonal ring with an 'A³²' group attached to its top-left position. Both structures are connected to the main formula III structure.

25

Z^{31} is $-\text{CH}=\text{CH}-$, $-\text{COO}-$, $-\text{CH}_2\text{CH}_2-$ or a single bond.

30

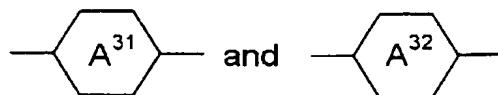
4. A liquid-crystal display according to Claim 2, wherein said medium comprises at least one compound of formula III



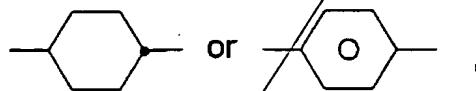
III

wherein

R³¹ and R³² are each, independently of one another,
5 alkyl having 1 to 7 carbon atoms,
alkoxy having 1 to 7 carbon atoms,
alkenyl having 2 to 7 carbon atoms,
alkenyloxy having 2 to 7 carbon atoms
or alkoxyalkyl having 2 to 7 carbon
10 atoms,



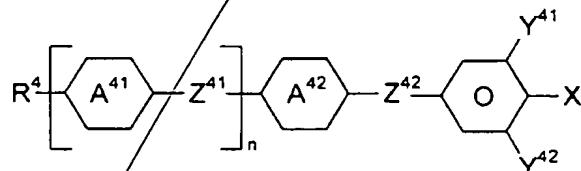
are each, independently of one another,



, and

15 Z³¹ is -CH=CH-, -COO-, -CH₂CH₂- or a single bond.

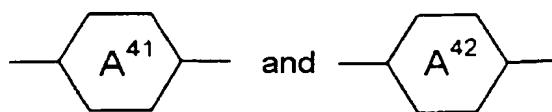
5. 20 A liquid-crystal display according to Claim 1, wherein said medium comprises at least one compound of formula IV



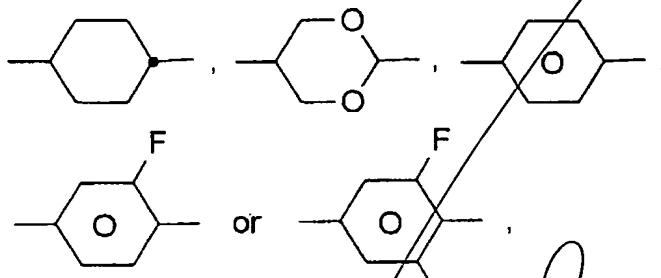
IV

25 wherein

30 R⁴ is alkyl having 1 to 7 carbon atoms,
alkoxy having 1 to 7 carbon atoms,
alkenyl having 2 to 7 carbon atoms,
alkenyloxy having 2 to 7 carbon atoms
or alkoxyalkyl having 2 to 7 carbon
atoms,



5 are each,
 independently of one another,



10 ,
 Z⁴¹ and Z⁴² are each, independently of one another,
 -CF₂O-, -COO-, -CH₂CH₂- or a single
 bond,

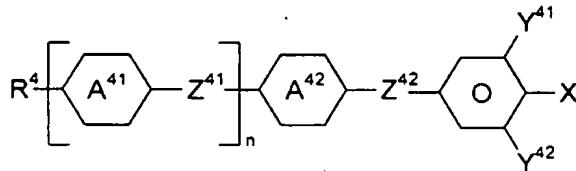
15 n is 0 or 1,

20 X is OCF₃, OCF₂H or F,

25 and

Y⁴¹ and Y⁴² are each, independently of one another,
H or F.

6. A liquid-crystal display according Claim 2,
 wherein said medium comprises at least one
 compound of formula IV

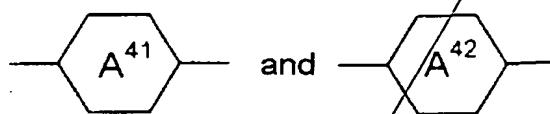


IV

wherein

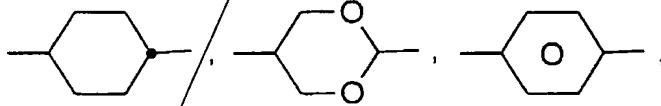
5 R⁴ is alkyl having 1 to 7 carbon atoms,
 alkoxy having 1 to 7 carbon atoms,
 alkenyl having 2 to 7 carbon atoms,
 alkenyloxy having 2 to 7 carbon atoms
 or alkoxyalkyl having 2 to 7 carbon
 atoms,

10



15

are each,
independently of one another,



20

Z⁴¹ and Z⁴² are each, independently of one another,
-CF₂O-, -COO-, -CH₂CH₂- or a single
bond,

25

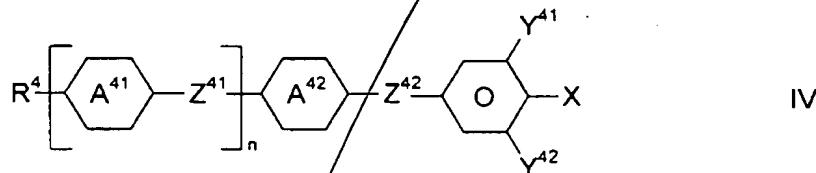
n is 0 or 1,

X is OCF_3 , OCF_2H or F,

and

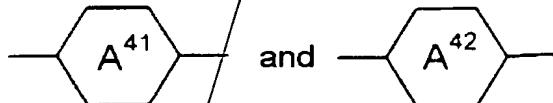
5 Y^{41} and Y^{42} are each, independently of one another,
H or F.

7. A liquid-crystal display according Claim 3,
10 wherein said medium comprises at least one
compound of formula IV



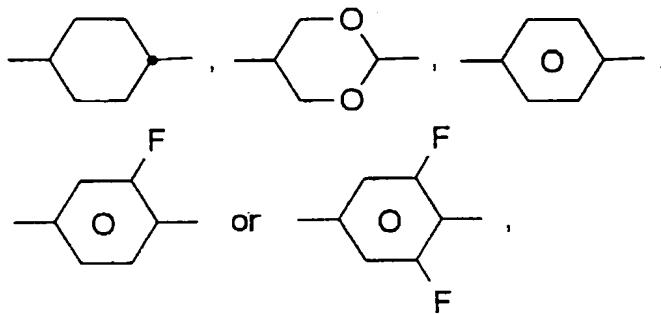
15 wherein

15 R⁴ is alkyl having 1 to 7 carbon atoms,
alkoxy having 1 to 7 carbon atoms,
alkenyl having 2 to 7 carbon atoms,
20 alkenyloxy having 2 to 7 carbon atoms
or alkoxyalkyl having 2 to 7 carbon
atoms,



and

25 are each,
independently of one another,

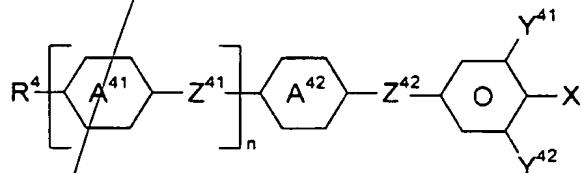


5 Z⁴¹ and Z⁴² are each, independently of one another,
 -CF₂O-, -COO-, -CH₂CH₂- or a single
 bond,

10 n is 0 or 1
 X is OCF₃, OCF₂H or F,

15 and
 Y⁴¹ and Y⁴² are each, independently of one another,
 H or F.

20 8. A liquid-crystal display according to Claim 4,
 wherein said medium comprises at least one
 compound of formula IV



IV

wherein

25 R⁴ is alkyl having 1 to 7 carbon atoms,
 alkoxy having 1 to 7 carbon atoms,
 alkenyl having 2 to 7 carbon atoms,
 alkenyloxy having 2 to 7 carbon atoms

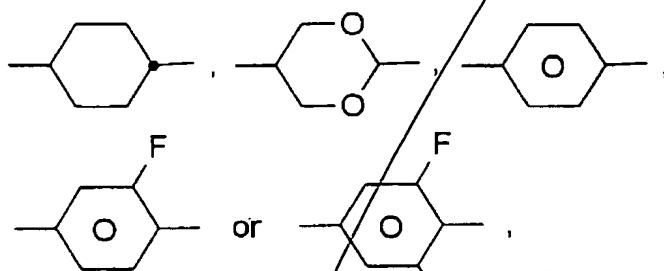
or alkoxyalkyl having 2 to 7 carbon atoms,



5

are each,
independently of one another,

10



15

Z⁴¹ and Z⁴² are each, independently of one another,
-CF₂O-, -COO-, -CH₂CH₂- or a single bond,

n is 0 or 1,

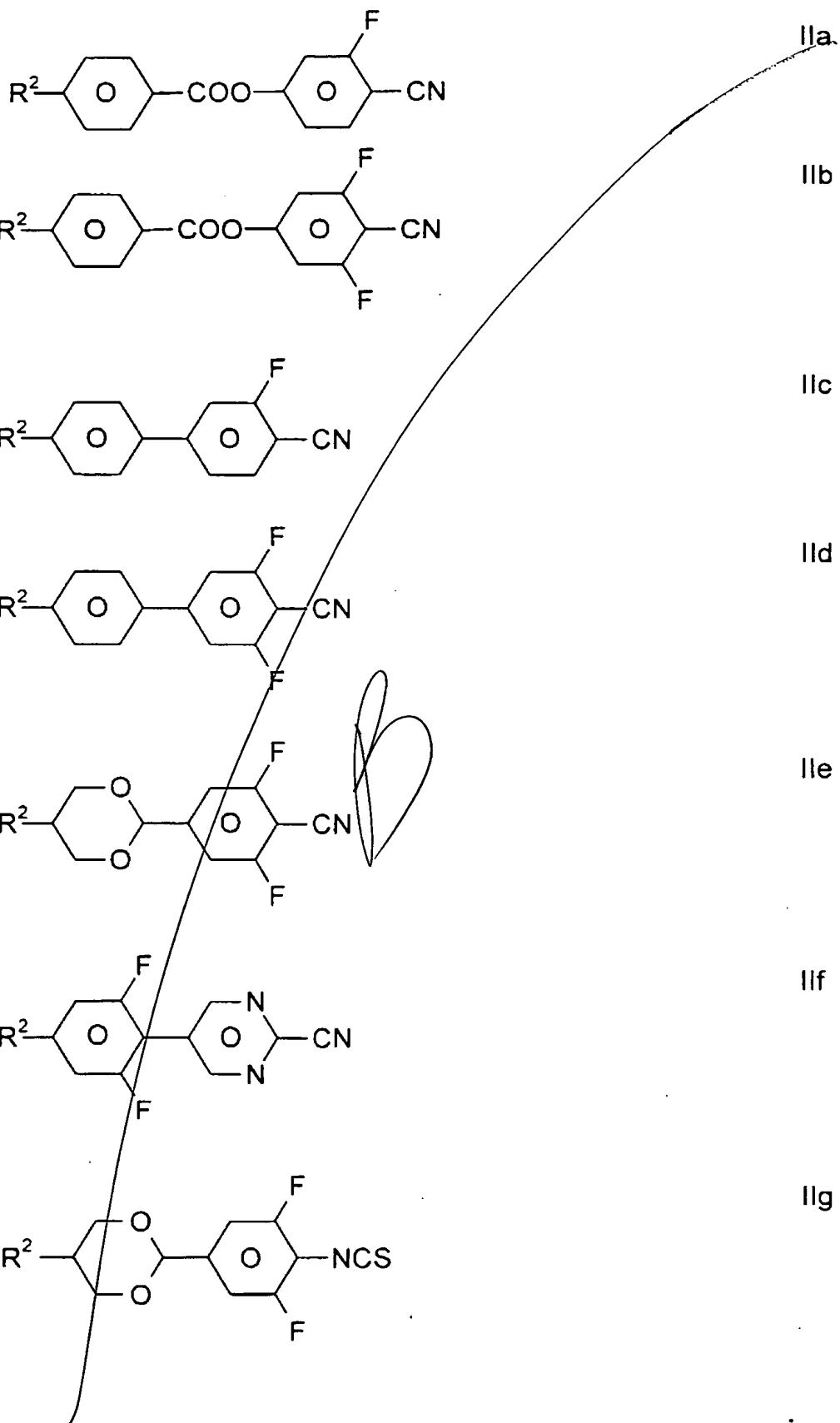
20

X is OCF₃, OCF₂H or F,

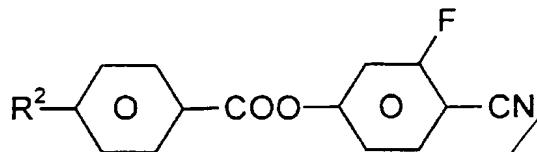
and

25 Y⁴¹ and Y⁴² are each, independently of one another,
H or F.

9. A liquid-crystal display according to Claim 2,
wherein medium comprises one or more compounds of
formulae IIa to IIg

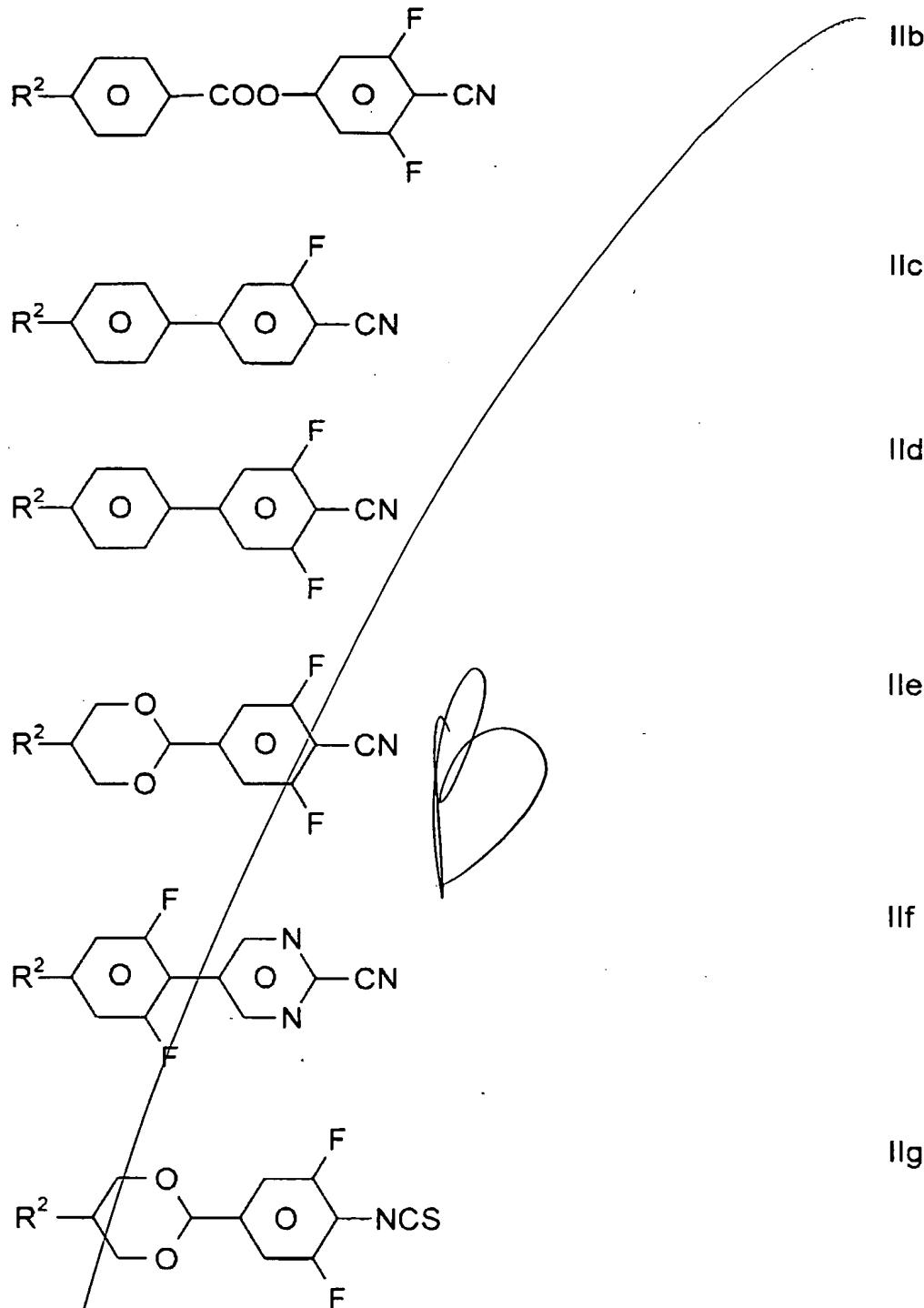


10. A liquid-crystal display according to Claim 4, wherein medium comprises one or more compounds of formulae IIa to IIg

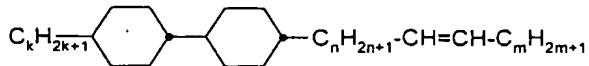


11a

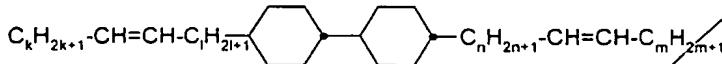
5



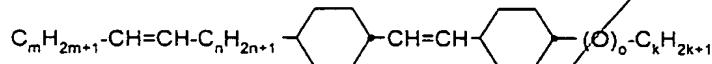
5 11. A liquid-crystal display according to Claim 3,
wherein said medium comprises one or more
compounds of formulae IIIa to IIIc



IIIa



IIIb



IIIc

wherein

5

k is 1, 2, 3, 4 or 5,

10

m and n are each 0, 1, 2 or 3,

15

m + n is ≤ 5 , and

o is 0 or 1.

15

12. A liquid-crystal display according to Claim 8,
wherein said medium comprises

20

- 1 to 35% of one or more compounds of the
formula I,

25

- 3 to 30% of one or more compounds of the
formula II,

25

- 3 to 45% of one or more compounds of the
formula III,

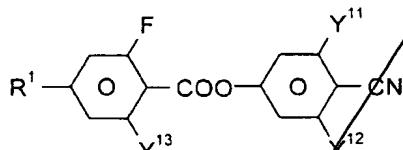
30

and
- 5 to 60% by weight of at least one compound of
the formula IV.

13. A liquid-crystal display according to Claim 1, wherein pixels of the display are addressed by means of an active matrix.

5
Sub 14. A liquid-crystalline medium of positive dielectric anisotropy comprising at least two liquid-crystal compounds

10 wherein at least one of said compounds is of formula I



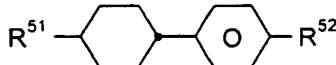
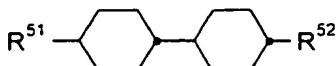
15 wherein

15 R¹ is H, alkyl having 1 to 7 carbon atoms, alkoxy having 1 to 7 carbon atoms, alkenyl having 2 to 7 carbon atoms, alkenyloxy having 2 to 7 carbon atoms or alkoxyalkyl having 2 to 7 carbon atoms, and

20 Y¹¹, Y¹² and Y¹³ are each, independently of one another, H or F.

25 15. In a method of generating an electro-optical effect using a liquid-crystal display, the improvement wherein a display according to claim 1 is used to generate said effect.

30 16. A liquid-crystal display according to claim 1, wherein said medium additionally comprises one or more compounds of formulae Va and Vb



Va'

Vb

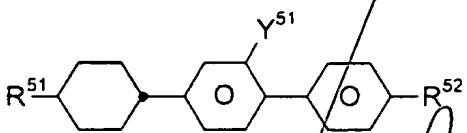
in which R^{51} and R^{52} are each, independently of one another, alkyl or alkoxy having 1 to 7 carbon atoms or alkenyl, alkenyloxy or alkoxyalkyl having 2 to 7 carbon atoms,

and/or

one or more compounds of formulae Vc and Vd



Vc



Vd

in which

R^{51} and R^{52} independently of one another, are as defined above, and

Y^{51} is H or F.

17. A liquid-crystal display according to Claim 8, wherein said medium comprises

- 2 to 30% of one or more compounds of the formula I,

- 5 to 25% of one or more compounds of the formula II,

- 5 to 40% of one or more compounds of the formula III,

and

- 5 - 5 to 50% by weight of at least one compound of
the formula IV.
- 10 18. A liquid crystal display according to claim 1,
wherein said medium has a birefringence of <0.12,
a flow viscosity at 20° of <30 mm² • s⁻¹, a
resistivity at 20°C of 5 x 10¹⁰ to 5 x 10¹³ Ω • cm,
a rotational viscosity at 20°C of <130 mPa • s, and
a clearing point above 60°C.
- 15 19. A liquid-crystal display according to claim 1,
wherein said medium has a birefringence of 0.05-
0.11.
- 20 20. A liquid-crystal display according to claim 1,
wherein said medium has a flow viscosity at 20°C of
15-25 mm² • s⁻¹.
- 25 21. A liquid-crystal display according to claim 1,
wherein said medium has a resistivity at 20°C of 5
x 10¹¹ to 5 x 10¹² Ω • cm.
- 30 22. A liquid-crystal display according to claim 1,
wherein said medium has a rotational viscosity at
20°C of 70-110 mPa • s.
23. A liquid-crystal display according to claim 1,
wherein said medium exhibits a storage stability
of at least 1000 hours at -30°C.

Add
C2 A3